

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference  TTCA-002WO	<b>FOR FURTHER ACTION</b>  see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No.  PCT/US2005/030841	International filing date ( <i>day/month/year</i> )  31/08/2005	(Earliest) Priority Date ( <i>day/month/year</i> )  30/09/2004
Applicant  TOKYO ELECTRON LIMITED		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

- ☒ the international application in the language in which it was filed  
☐ a translation of the international application into \_\_\_\_\_, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (See Box No. II)

3. ☐ **Unity of invention is lacking** (see Box No. III)

4. With regard to the **title**,

- ☒ the text is approved as submitted by the applicant  
☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

- ☒ the text is approved as submitted by the applicant  
☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings**,

- a. the figure of the **drawings** to be published with the abstract is Figure No. 3  
☒ as suggested by the applicant  
☐ as selected by this Authority, because the applicant failed to suggest a figure  
☐ as selected by this Authority, because this figure better characterizes the invention  
b. ☐ none of the figures is to be published with the abstract

## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2005/030841

## A. CLASSIFICATION OF SUBJECT MATTER

INV. H01L21/311 H01L21/316

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2003/109106 A1 (PACHECO ROTONDARO ANTONIO LUIS ET AL) 12 June 2003 (2003-06-12) paragraphs [0019] - [0025] -----	1-10, 16-19, 21
X	US 2004/129674 A1 (BEASE GORDON ET AL) 8 July 2004 (2004-07-08) paragraphs [0005], [0006], [0019], [0020], [0054], [0055] -----	1-4, 6, 10-14, 16
X	US 2004/105213 A1 (EGGER ULRICH ET AL) 3 June 2004 (2004-06-03) paragraphs [0016], [0017], [0025] - [0028] -----	1-4, 6, 8, 10, 15
X	US 6 232 174 B1 (NAGATA MASAYA ET AL) 15 May 2001 (2001-05-15) column 5, paragraph 3; figures 2b, 2c column 6, paragraphs 2, 3 -----	1, 5, 8, 10

☐

Further documents are listed in the continuation of Box C.

☒

See patent family annex.

## \* Special categories of cited documents :

\*A\* document defining the general state of the art which is not considered to be of particular relevance

\*E\* earlier document but published on or after the international filing date

\*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

\*O\* document referring to an oral disclosure, use, exhibition or other means

\*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*Z\* document member of the same patent family

Date of the actual completion of the international search

10 May 2006

Date of mailing of the international search report

31/05/2006

Name and mailing address of the ISA/

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Authorized officer

Kenevey, K

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2005/030841

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 2003109106	A1	12-06-2003	NONE		
US 2004129674	A1	08-07-2004	NONE		
US 2004105213	A1	03-06-2004	AU 2003283942	A1	23-06-2004
			DE 10393802	T5	06-10-2005
			WO 2004051711	A2	17-06-2004
US 6232174	B1	15-05-2001	NONE		

# PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

## PCT

### WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.1)

Date of mailing  
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference  
see form PCT/ISA/220

**FOR FURTHER ACTION**  
See paragraph 2 below

International application No.  
PCT/JS2005/030841

International filing date (day/month/year)  
31.08.2005

Priority date (day/month/year)  
30.09.2004

International Patent Classification (IPC) or both national classification and IPC  
INV. H01L21/311 H01L21/316

Applicant  
TOKYO ELECTRON LIMITED

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

#### 2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:



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Date of completion of  
this opinion

see form  
PCT/ISA/210

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**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/US2005/030841

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**Box No. I Basis of the opinion**

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1. With regard to the **language**, this opinion has been established on the basis of:
  - ☒ the international application in the language in which it was filed
  - ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
  - a. type of material:
    - ☐ a sequence listing
    - ☐ table(s) related to the sequence listing
  - b. format of material:
    - ☐ on paper
    - ☐ in electronic form
  - c. time of filing/furnishing:
    - ☐ contained in the international application as filed.
    - ☐ filed together with the international application in electronic form.
    - ☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/US2005/030841

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**Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	20
	No: Claims	1-19, 21
Inventive step (IS)	Yes: Claims	
	No: Claims	20
Industrial applicability (IA)	Yes: Claims	1-21
	No: Claims	

2. Citations and explanations

**see separate sheet**

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

Reference is made to the following documents:

- D1: US 2003/109106 A1 (PACHECO ROTONDARO ANTONIO LUIS ET AL) 12 June 2003 (2003-06-12)  
D2: US 2004/129674 A1 (BEASE GORDON ET AL) 8 July 2004 (2004-07-08)  
D3: US 2004/105213 A1 (EGGER ULRICH ET AL) 3 June 2004 (2004-06-03)

- 1 The present application does not meet the criteria of Article 33(1) PCT, because the subject matter of claims 1-19, 21 is not new in the sense of Article 33(2) PCT.

- 1.1 The document D1 discloses (paragraphs [0019]-[0025]; figures 2, 3):

method for forming a thin high-k layer on a substrate, the method comprising:  
providing a substrate in a process chamber;  
depositing a high-k material to at least a minimum thickness to form a thick complete high-k layer on the substrate; and  
thinning the thick complete high-k layer to a desired thickness less than the minimum thickness to form a thin complete high-k layer.

Therefore the subject matter of claim 1 is not new.

- 1.2 D1 further discloses all of the features of claims 2-10, 16-19, 21. Note that the "interface layer formed on a substrate" is disclosed in paragraph [0019], though this is not illustrated explicitly in figures 2, 3.
- 1.3 D2 discloses (paragraphs [0054], [0055]) all of the features of claims 1, 10 and further discloses (paragraph [0020]) that the plasma process gas contains HBr or HCl and an inert gas such as He. Therefore, claims 11-14 are not new. After the plasma process which modifies the high-k dielectric layer in D1, a wet processing step is carried out to remove the modified portion. Hence the subject matter of claim 16 is

disclosed.

- 1.4 D3 discloses (paragraphs [0027], [0028]) all of the features of claims 1, 10 and further discloses (paragraph [0028]) that the plasma process is a reactive ion etch. Thus the feature of claim 15 lacks novelty.
- 2 The present application does not meet the criteria of Article 33(1) PCT, because the subject matter of claim 20 does not involve an inventive step in the sense of Article 33(3) PCT.
  - 2.1 A reactive ion etch is a standard technique used in the art to thin a hafnium-containing layer (see for example, D3 paragraphs [0016], [0017]) and no inventive merit can be attributed to its employment.